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REVIEW OF DRAFT
HOT SPOT FEASIBILITY STUDY, NEW BEDFORD HARBOR,
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Review by:

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The review of this report is divided into two sections: a general summary section and more detailed comments on specific sections of the report.

SUMMARY

The report reads as if the desired conclusion was known *a priori* and the report was produced to satisfy the need for a feasibility study. The selection of the hot spot as a separate entity in the overall remediation of New Bedford is arbitrary and was selected without justification or documentation. Furthermore, the role of the hot spot remediation in the overall remediation of the New Bedford site is never addressed. This further strengthens the sense that the whole exercise was performed to "do something" without concern for an objective analysis of the various proposed remediation measures. Most of the evaluations performed to support the remediation measures are purely speculative and lack supporting analyses.

SPECIFIC COMMENTS

1. The executive summary stresses (p. ES-3 & 4) the need to consider the proposed hot spot remediation action in concert with the overall remediation plan for the area. When it comes to the screening and detailed evaluation steps, however, this issue is totally ignored.

This coordination and consistency should be of critical concern. As an example, if the hot spot is dredged and the diffusive PCB flux transport mechanism (ASA, 1987) is assumed to be the primary transport process, then PCBs are likely to be deposited in the "cleaned" hot spot area by diffusive flux from the water column. This process is already taking place in the upper estuary where sediment PCB concentrations are less than 50 ppm. If the sediment PCB concentrations, down to a 10 ppm level, are removed from the hot spot, then the "cleaned" area will receive PCBs from the water column. If the rates of PCB transport are sufficiently large the hot spot area may need to be remediated again. This would clearly be a waste of time and resources.

2. The definition of the hot spot area is totally arbitrary. Contrary to what is stated in the report (p. 2-5) the target level is <u>not</u> necessarily a "common sense" level nor is it an optimization of sediment remediation volume and PCB mass removal/treatment.

   Treating sediments at the 30,000 ppm level requires a remediation volume of 4,400 cy and reduces PCB mass by 32% (Table 1, Figure 1). Lowering the target level to 20,000 ppm increases the volume to be treated by 2,000 cy and removes 41.8% of the PCB mass, an increase of 9.8% over the 30,000 ppm target level (Figure 2). If the target level is further lowered to 10,000 ppm an additional 2,300 cy must be treated but the benefit is only a 3.7% reduction in PCB mass.

   On a PCB mass removed divided by the volume required to be treated basis the incremental reduction from the 30,000 to 20,000 ppm target level compared to the 20,000 ppm to 10,000 ppm is reduced by more than one half (Figure 3). The incremental benefit in treating at increasing lower target levels continues to decline.

Table 1 Acushnet River estuary data interpretation (PCB target levels, remediation volume, % PCB mass) (Ebasco, 1989, Table 2-1).

Hot Spot Feasibility Study
New Bedford Harbor, Massachusetts

PCB Target Level Concentration (ppm)	Cumulative Remediation Volume (cy)	% Mass of PCBs
500	200,000	89.0
1,000	92,000	82.0
2,000	66,000	77.0
3,000	39,000	63.0
4,000	10,000	48.0
5,000	9,700	47.6
6,000	9,500	47.2
7,000	9,300	46.8
8,000	9,100	46.5
9,000	8,900	46.2
10,000	8,700	45.5
20,000	6,400	41.8
30,000	4,400	32.0

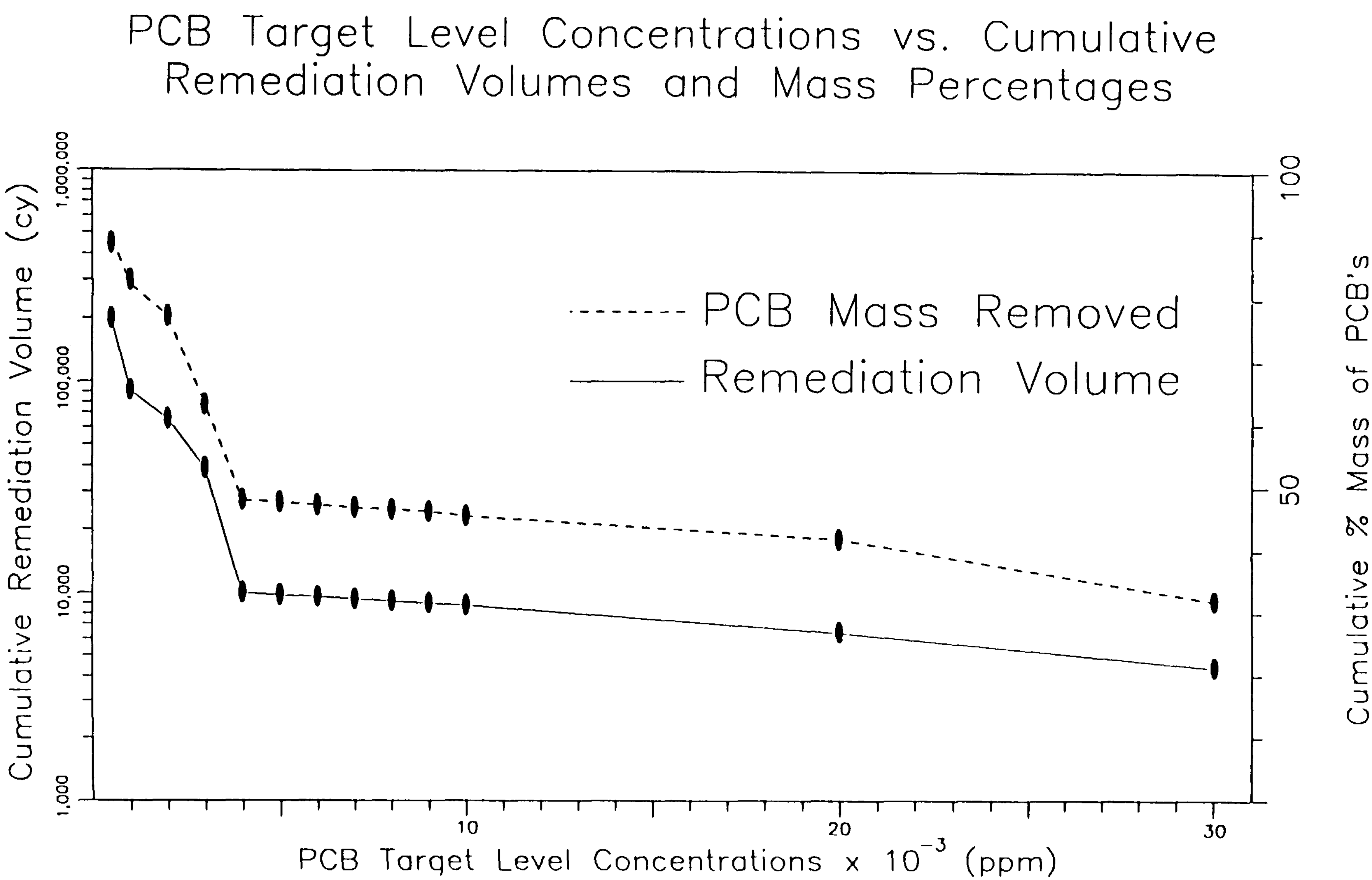

Figure 1 Cumulative remediated volume (cy) and cumulative PCB mass reduction (%) versus sediment PCB target levels (ppm) for New Bedford Harbor sediments.

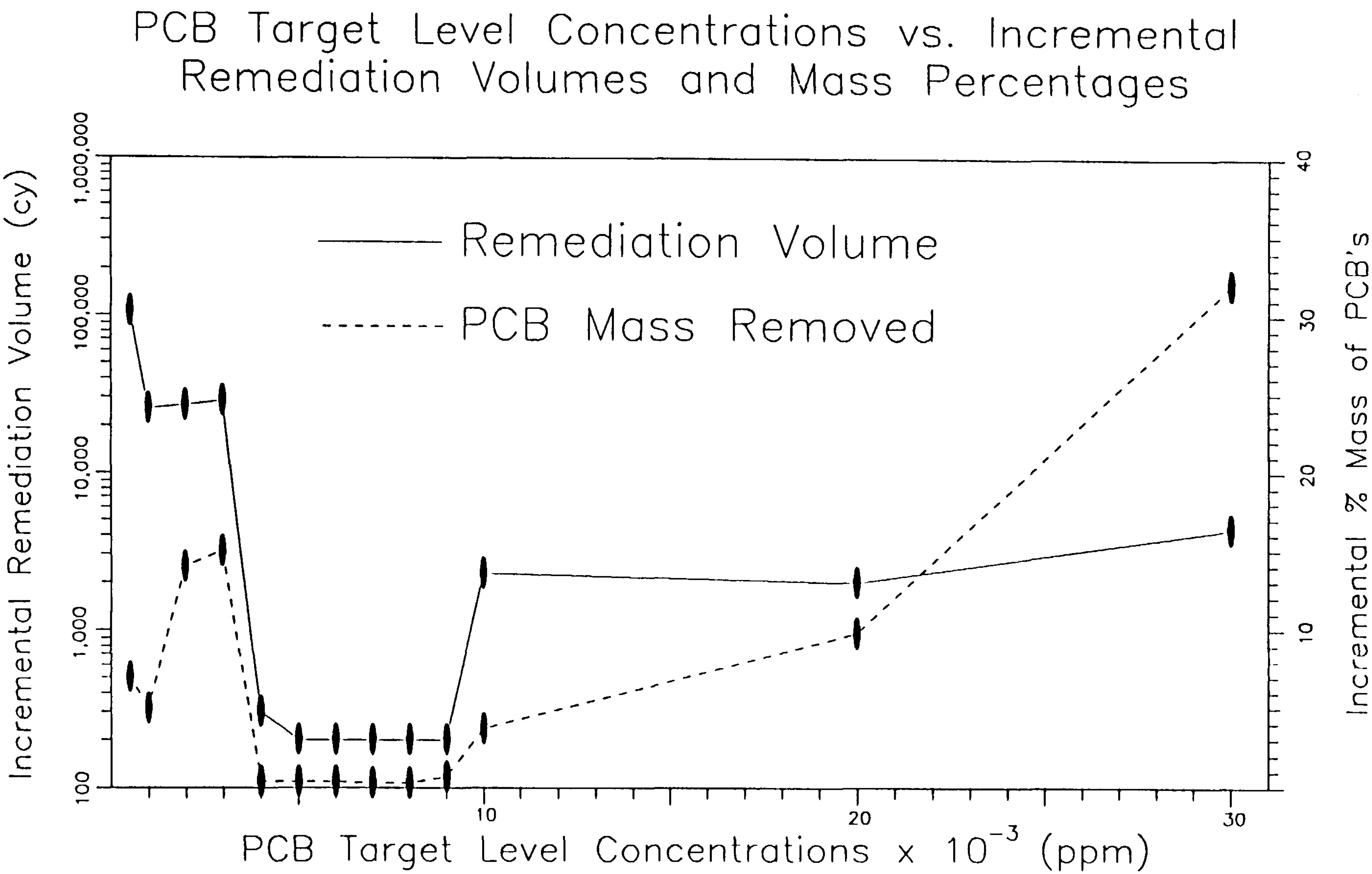

Figure 2 Incremental remediated volume (cy) and incremental PCB mass reduction (%) versus sediment PCB target levels (ppm) for New Bedford Harbor sediments.

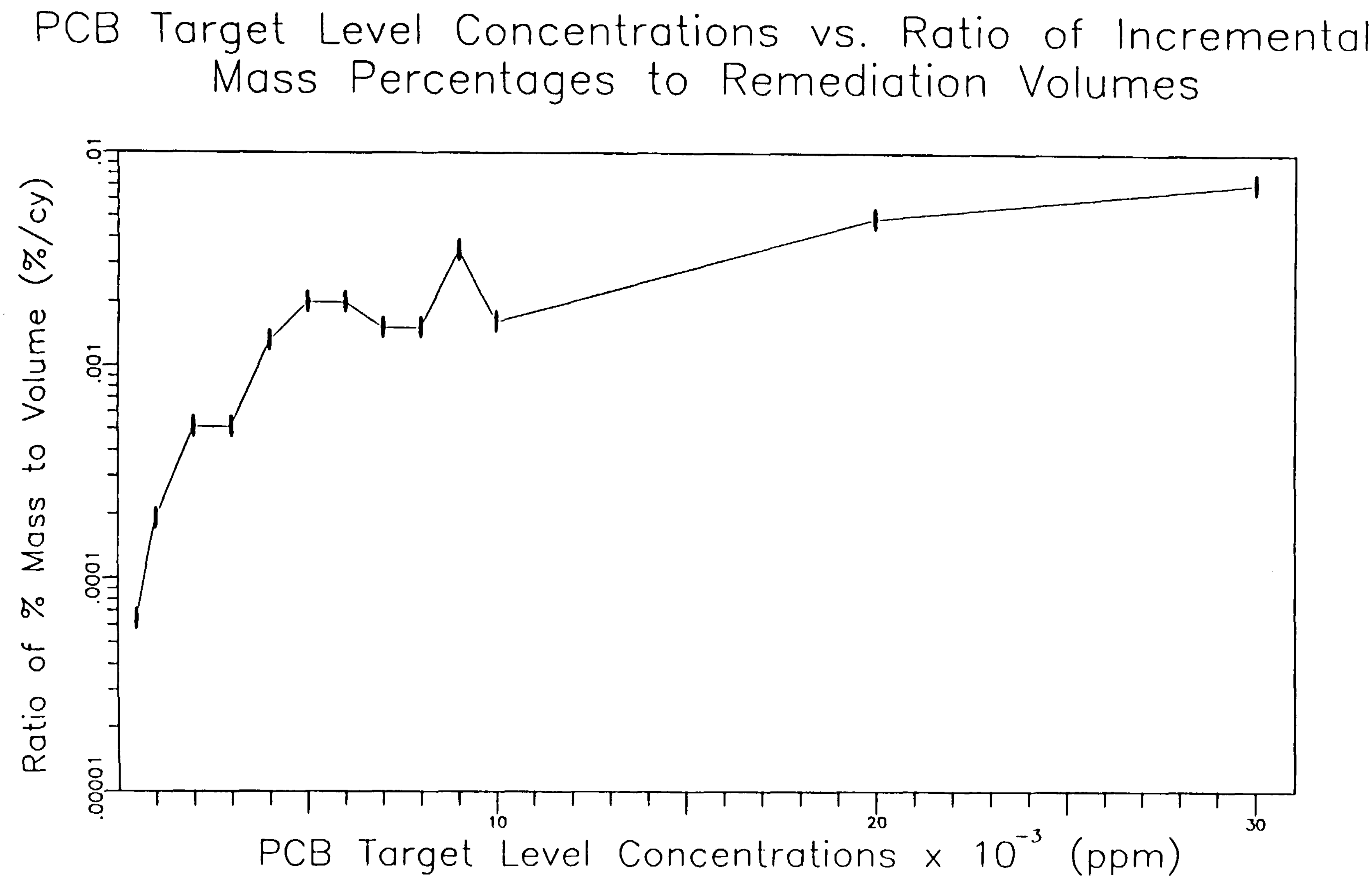

Figure 3 Ratio of incremental PCB mass reduction (%) to remediated volume (cy) versus sediment PCB target levels (ppm) for New Bedford Harbor sediments.

In general, as the target level declines, the volume of sediments which must be remediated for each % of PCB mass removed continues to increase. The exception is at a target level of 9000 ppm which shows a local maximum in the ratio of % PCB mass removed to volume remediated. This local maximum could readily be caused by uncertainties in contouring of the sediment PCB data.

Figure 3 suggests that a target level of 9000 or 10,000 ppm is more appropriate than the proposed 4,000 ppm level.

It is interesting to note that exactly 200 cy must be treated to achieve each 1000 ppm increment reduction in the target level for target levels between 10,000 and 5000 ppm. This is clearly shown in Figure 2. At first glance one would suspect that the data in this range were artificially generated.

3. The use of the word "common sense" to justify the PCB target level is amazing. It implies that there is some universally accepted standard for selection of the target. This is not the case. What is even more disturbing is that no analysis is provided to support the selection.

4. Throughout the report there is an assumption that the hot spot is a principal source of contamination for the estuary. This assumption is ultimately used to justify treatment of the hot spot sediments. No proof of any kind, however, is offered to show how the PCBs in the hot spot or in any other sediments in the upper estuary enter the water column.

   Annexed hereto are descriptions of two methods of analysis that could have been employed to analyze the flux of PCBs from the hot spot. The first involves direct measurement of benthic flux in the field; the second is an analytical analysis.

5. There is an inherent assumption that reduction in total PCB mass (independent of location) leads to an equivalent reduction in the long term transport of PCBs from the site and, hence, to reduced risks. From an environmental risk perspective, however, there is an important difference between PCBs which are potentially mobile (in the near surface sediments) and those that have severely limited mobility (deeper in the sediments). From a risk assessment viewpoint removal of mobile, near surface sediments, independent of their total mass, is more important than the total mass of PCBs removed. The use of total PCBs removed as the only measure of acceptability of a remedial action technique is simplistic.

6. The report is devoid of any real analysis on how the proposed remediation measures will impact the environment. No calculations or analyses are given as to the effects of the removal of the hot spot on the transport of PCBs out of the upper estuary, impacts to the ecosystem or public health risks. The authors rely solely on reduction in PCB mass as the measure of impact reduction. On the other hand there is extensive analysis of the costs associated with each remedial action measure.

   It is impossible to perform a realistic, justifiable feasibility assessment without being able to have some reasonable measure of impact. The lack of any impact analysis is a critical flaw in the work. Acceptance of the simplistic assessment performed for the Hot Spot study would represent a major step backward in feasibility assessments.

7. Documentation in the report is extremely poor. Many important conclusions or statements are made without supporting analysis or appropriate references to the literature. The general level of referencing is bleak.

8. The report is littered with qualified statements. The use of "may, might, believed, probable, could, possible, perhaps" is extensive. The impression is

that nothing is really understood nor are the authors willing to stand behind any of the statements made.

9. The section on PCB transport and fate (Section 2.3) is riddled with speculation, misconceptions and errors. Several of the more glaring examples are given below. In each case a quote from the report is given in italics followed by a response.

p. 2-21 *...the Hot Spot area acts as a source of PCBs to the remainder of the estuary and lower harbor and bay.*

This statement is made without any analysis or reference to other literature or reports to support the assessment. The statement is entirely speculative.

p. 2-21 & 22 *Vertical migration of PCBs within the Hot Spot sediment is believed to be currently occurring. Two possible mechanisms for this migration are: (1) the solubilization of PCBs due to detergent-like agents present in the sediment pore water; and (2) bioturbation.*

Vertical migration due to molecular diffusive transport of PCBs deeper into the sediments, the role of sedimentation and partitioning of PCBs onto these freshly deposited sediments, and biodegradation within the sediments are all ignored in this presentation.

p. 2-23 *Calculations from one study indicates that the total PCB flux from the sediment to the overlying water column was 160.5 and 214 kilograms per year (kg/yr), (ASA, 1987). This model further demonstrated that the flux of PCBs from the sediment is primarily controlled by the interstitial pore water PCB concentrations and the thickness of the diffusive layer. This observation is significant in that the estuary receives water with lower PCB levels not only by the freshwater inflow of the Acushnet River but also by tidal fluctuations. The continual exchange of cleaner, less PCB-contaminated water with the contaminated* *sediment pore water may act to increase diffusion of PCBs from the sediment to the pore water and subsequently to the water column.*

The first two sentences in the above paragraph are correct. The third is confusing and the fourth is incorrect.

It is supposed that the third sentence suggests that water on the flood tide has lower PCB concentrations than the ebb tide water and, hence, results in PCB transport out of the upper estuary due to tidal pumping.

The fourth sentence implies that there is an exchange of cleaner, less PCB contaminated water with the contaminated sediment pore water. This is not the case. PCBs in the pore water are transported to the overlying water column by diffusive transport. There is, however, no exchange of water.

<u>p. 2-24</u> *Water quality sampling at 17 stations located throughout the estuary, lower harbor, and bay indicates that the water in the vicinity of the Hot Spot contained a total of 13,754 ng/l of PCBs when compared to 236 ng/l for the lower harbor, and 58 ng/l for the bay.*

Battelle (1987) collected data at only two stations in the upper estuary; one station near Aerovox and the second just upstream of the Coggeshall Street Bridge. Figure 4 shows a summary of the total PCB concentration data for these two stations as well as the remaining stations in the survey. All three cruises are included in this data set.

Contrary to what is reported the mean concentration level in the vicinity of the hot spot is 4,000 ng/l <u>not</u> the 13,754 ng/l reported. The lower harbor and bay data, however, are consistent with Battelle's data.

<u>p. 2-25</u> *The Hot Spot area of the estuary contains approximately 48 percent of the mass of PCBs and therefore functions as a major source of PCB contamination.*

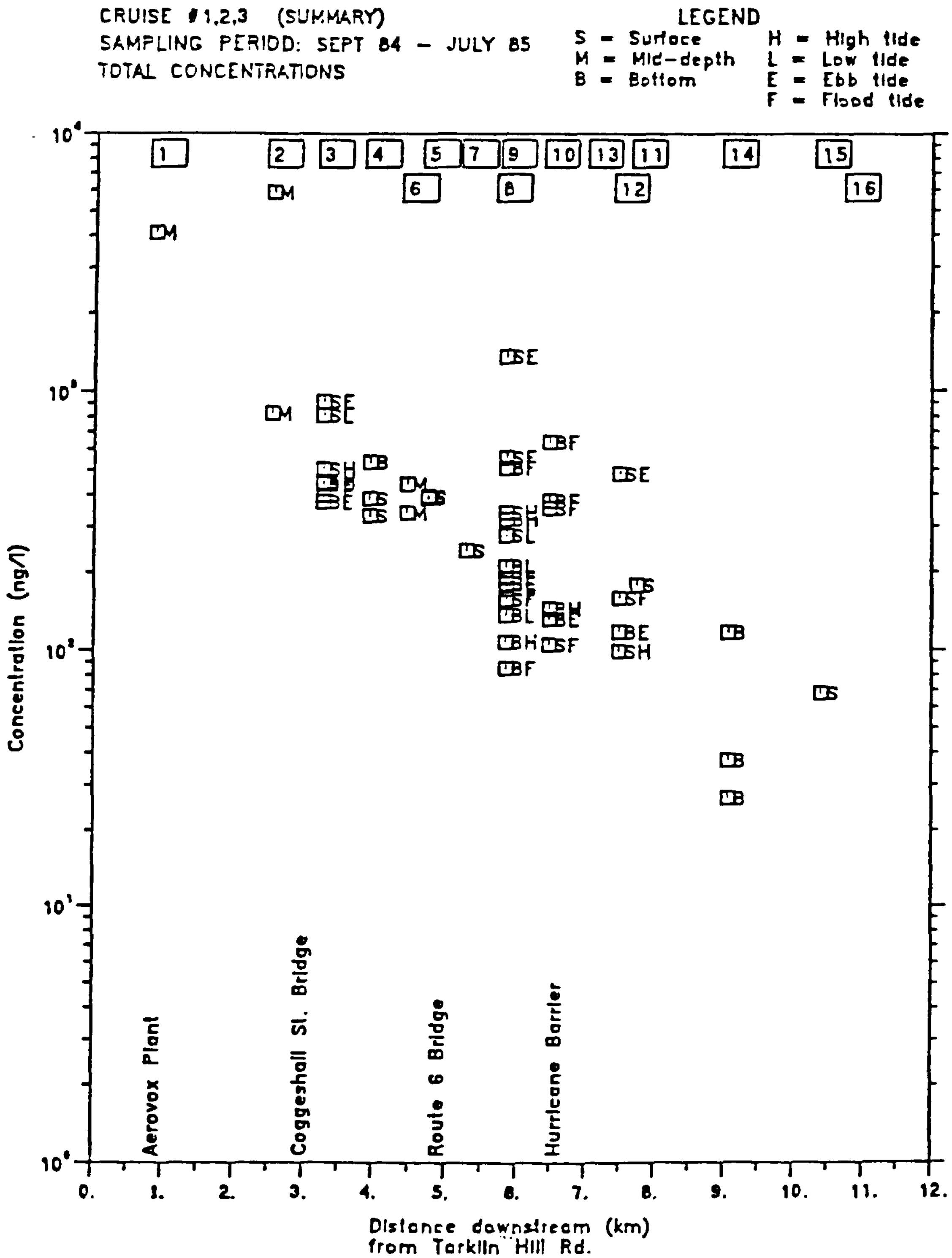

Figure 4 Total PCB water column concentrations (ug/l) versus longitudinal distance (km) for Battelle's data (1987). Summary of cruises 1, 2, and 3.

This statement is purely speculative without supporting analysis or reference to prior analyses. Furthermore, it gives the false impression that because there are substantial quantities of PCBs in the sediment, it is a major source.

10. The treatment of the various alternatives, particularly the evaluation portion, is uneven. The capping alternative is singled out for particularly harsh evaluation, again without supporting documentation.

As examples:

p. 6-13 *Studies by USACE have shown that boat traffic and associated propeller wash have caused release of floating oil sheen containing PCBs from the Hot Spot sediment (Teeter, 1988). Cap construction, including the associated transport of the capping materials to the Hot Spot, is expected to cause release of PCB-contaminated sediment. Environmental control measures (e.g., silt curtains and oil booms) would be necessary to mitigate this release. However, results of the pilot study indicated that the installation, position, and removal of a silt curtain used during the study caused significant sediment resuspension (Otis, 1989).*

The suggestion here is that the construction activity in placing the cap leads to significant releases of PCB into the water column. It further indicates that placement of a silt curtain to control such releases itself results in significant sediment resuspension. There is no analysis to support any of these speculative statements.

The authors have shown a surprising lack of imagination in conceptualizing an engineering solution to the above problem. A simple steel sheet pile wall placed around the hot spot would isolate it from the remainder of the upper estuary and allow capping to be performed without significant release of PCBs.

p. 6-13 *The long-term effectiveness of this alternative is questionable. The bearing strength of the underlying sediment is not believed to be adequate to support a cap. It is very likely that during cap installation the cap material will mix readily with the contaminated sediment. Resuspension of contaminated sediment during placement of cap material may also occur.*

Their analysis of long term effectiveness is purely speculative. It is difficult to justify the argument that the underlying material is not sufficient to support a cap when the U.S. Army Corps has just constructed a CDF in the upper estuary.

p. 6-14 *If the cap is effective in covering the Hot Spot sediment, the sediment would remain in-place and could be re-exposed by future events, either natural (e.g., floods) or man-made (e.g., development).*

No analysis or scenarios are presented on ways in which the hot spot sediments could be re-exposed by future events.

p. 6-14 *Raising the estuary by 3 feet in this area would be expected to adversely affect the adjacent wetlands area.*

It is unclear how the impact on the adjacent wetlands occurs. It would seem that capping with 3 ft of sediment would ultimately increase wetland area in the upper estuary.

p. 6-15 *Conclusion. This alternative will be eliminated for further analysis. This alternative is inconsistent with the requirements of SARA to permanently reduce the mobility, toxicity, or volume of wastes. Implementation of this alternative is expected to cause an increase in PCB mobility. In addition, this alternative has questionable long-term reliability and may not comply with CWA ARARs. This alternative is expected to have an impact on adjacent wetland areas.*

This conclusion is based on a series of unfounded, undocumented speculations. The idea that this "alternative is expected to cause an increase in PCB mobility" is clearly contrary to field and laboratory experience that the U.S. Army Corps has with capping (e.g., Long Island Sound, Puget Sound).

11. Throughout the report atmospheric transport of PCBs is given only cursory treatment. Thibodeaux (1989), in his work for the U.S. Army Corps, has shown that evaporative losses may be very significant in the upper estuary.

12. The report relies extensively on the results of the U.S. Army Corps of Engineers pilot dredging study to justify the selected remediation measures. Unfortunately, references to this work are generally in the form of personal communications. As such they are not subject to independent evaluation and critique.

13. There is no rationale given as to why the pilot dredging program performed in a cove in the lower part of the upper estuary should apply to the hot spot. It would appear at first glance that the areas are substantially different. The hot spot is located in the main channel of the Acushnet River estuary, which is more subject to tidal and river flows than at the pilot study site. The PCB concentrations in the hot spot are significantly greater than those in the cove. The distance to significant wetlands is closer for the hot spot than in the cove. The water depths are shallower in the vicinity of the hot spot than the pilot site. These differences raise questions as to the applicability of the pilot study results for the hot spot.

REFERENCES

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ANALYSIS OF PCB FLUX FROM SEDIMENTS

Direct Measurement

Enclosing areas of sediment and measuring changes in the trapped overlying water is a technique widely used in the measurement of sediment oxygen demand and nutrient exchange rates. With some modification this methodology is applicable to the measurement of the benthic flux of PCBs. The enclosures require a circulation system to maintain water movement within the chambers and some means of sampling the chamber contents for the large samples required for PCB analyses. In addition, special attention must be paid to appropriate construction materials and experimental protocols to allow for the relevant properties of PCBs, especially their hydrophobic nature.

Several experimental chambers are placed over the sediment along with a control chamber which contains water from the same environment but is isolated from the sediment with a bottom plate. After placing the chambers and leaving them open to the environment for an appropriate period to allow for some resuspension of sediment and adsorption of PCBs to chamber surfaces, the chambers are sealed and initial samples taken. Additional samples are taken over a sufficient period of time to observe increases of PCB concentrations in the contained water without allowing the water to become anoxic. Flux rates calibrated from these measurements should be corrected for changes observed in the control chamber.

When the chambers are removed at the termination of the experiment, samples of sediment should be taken from beneath the chambers and analyzed for PCB concentration. A series of such experiments should allow an evaluation of the correlation of benthic flux of PCBs to their concentration in the sediment.

Analytical Approach

The flux of PCBs from the upper estuary sediments could also be estimated by using an analytical model. Either a one- or two-layer, analytic, diffusive transport model could be employed. Sediment sampling programs in the upper estuary provide PCB data with which the model can be calibrated.

A possible two-layer model for the diffusive flux of PCBs from the sediments describes the change in PCB sediment concentration with time in terms of the vertical diffusion of PCBs. At the sediment-water interface the total flux of PCBs from sediments to water column is specified in the form of a mass transfer equation written in terms of the sediment-pore water PCB concentration and the water column dissolved PCB concentration. At the bottom of the lower sediment layer, the PCB concentration is assumed to be zero; and at the interface between the two layers, the PCB concentrations are equal. The initial conditions are that the upper layer has a uniform concentration and the lower layer has a concentration that decreases exponentially with depth. This model is extremely simple in approach, lumping all the mixing processes into single diffusion parameters.